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DO not fail to read Professor Noyes' paper in this issue. Its suggestions are both forcible and timely. His subject is one upon which every student of the Institute could undoubtedly contribute a page or more of bitter experience, and then not relate one-half the record of trials encountered. What new comer to the Polytechnic has not bemoaned his fate in not knowing how to study, and what conscientious student has not devoted the first three or four months of his course to the attempted mastery of this art! Would that all succeeded in the ambitious undertaking. Would that every one was rewarded with at least an inkling into its mysteries. Then would the mortuary record assume far less imposing proportions. Who will deny that scores of good workers have stumbled along, year after year, satisfying neither themselves nor the faculty, simply for the reason that they knew not how to make their efforts count. At a minute's warning a dozen such men could be cited. In several instances the examinations proved too much and they succumbed. Unquestionably, were they entitled to far better standing than many of their more fortunate classmates, had individual worth been the basis of consideration, yet undeniably were they unworthy of advancement. Through want of system and proper balancing in study their work became so confused that it would have been injustice to them and to the classes to have allowed them to go on and thus plunge them still deeper in their complications. The conclusion to be drawn from such experience is involuntary—the student who cannot learn to study cannot be a success in a scientific school. By no means is it to be said that he cannot become a success in life. Far be it to the contrary. He is perhaps destined to meet with greater victories, in the eyes of the world, than his companion who was a success in scientific work. He needs, however, to avoid technical schools, and look about him for that direction in which his ability and tastes tend. No student, or prospective student, on the other hand, is justified in giving up to the difficulties such a course as ours presents, until he is thoroughly convinced that his efforts to follow the suggestions of those who appreciate his position avail him nothing. When he has discovered the differences between study in a High school and study in a technical school, and has found he is not able to adapt himself to these differences, then it is time to think of giving up.

* * *

IN this connection another observation demands brief consideration. It is that many failures in term examinations at Rose are due, not to individual inability to master the work of the course, but to lack of sufficient preparation for it. To undertake to build a high structure on a weak foundation is to be rewarded with the inevitable result—collapse. Young men make a great mistake when they endeavor to enter at the age of sixteen, merely because they are eligible to entrance at that age, regardless of the thoroughness of their preparation. It is not enough that they shall have "completed the third year" of the High school. It is not even enough that they shall have been "graduated." It is necessary that they shall have digested the subjects they have studied. This digestion may, it is true, come at the age of sixteen. Far more likely, though, is it to come at eighteen or nineteen. Of what advantage is it to spend four such valuable years as those from the age of seventeen to twenty-one pursuing, superficially, a course of study intended to equip one thoroughly for an advanced position in life. How much better would it be to consume a year or two more in preparation and then accomplish something worthy of mention when the Polytechnic course is undertaken. It is a great mistake, also, for the prospective Poly man to devote himself exclusively to those branches which are actually required in the preparation for his future study. Let him learn something of history, literature, rhetoric, science of government, and some of those other branches which make it possible for a young man to live among intelligent, cultured people and be one of them, and which tend to broaden his mind to an extent that permits a fuller appreciation of the force of all things submitted for his comprehension. It is one thing to be a specialist, limited to your profession, quite another to be a specialist with a fund of outside information at command that permits an insight into other fields. So, in preparation, really prepare, and let the basis be a broad one. Then, when you enter R. P. I. have no fear but that success will be yours.

* * *

MATHEMATICS in High schools was the subject of a paper read by Professor Waldo before the mathematical section of the State Teacher's Association, which met in Indianapolis during the holiday vacation. As is customary in these meetings discussion followed the reading of the paper. The very first speaker, in this discussion, was a High school man who, so report goes, rose to inquire what Professor Waldo knew about mathematics in High schools and whether he had visited a single High school in recent years. Mr. Waldo was not called upon to reply, for immediately a second member made the statement that the Professor had visited his school quite recently. It occurs to us that the first speaker failed to grasp the situation in any respect. Upon reflection he might rather have asked what Professor Waldo did not know about mathematics in High schools. If any mathematician in the state has had better opportunity to become conversant with High school methods of instruction in mathematics than he, such an individnal has been highly favored. As Professor of Mathematics here, he had immediate charge of students from not less than sixty High schools each year, and by his method of teaching could hardly fail to discover just how each man had been taught. If he did fail to learn about all there is to be learned concerning the plans of instruction in High schools, he simply failed to take advantage of his opportunities. The opinion is ventured that such was not the case.

* * *

AS was anticipated, the appearance in THE TECHNIC of carefully prepared scientific papers by graduates has met with early recognition from the leading technical journals. In the issue of the *Engineers' Record*, for January 2d, is published a liberal extract from Mr. Taro Tsuji's article on "shore protections," for which both the author and this paper are given credit. From indirect sources it has been learned that the *Engineering News* expects to publish the same article entire in the near future. Such recognition is certainly merited by THE TECHNIC's contributors and we hope also by us.

* * *

THE fire was paradoxical in the truest sense, unfortunate and yet fortunate. To contemplate what might have been and then to view what is, discloses cause for warm congratulation. Had not the flames been supplanted by icicles just when they were, one of the best equipped laboratories in the country would have been a mass of ruins, incurring a loss, the seriousness of which could hardly be estimated in dollars. Fortune favored us in rich measure, and appreciation of the fact will be shown in the most rapid recovery this section of civilization has observed for some time.

A STRANGE fatality was attached to the office of president of the class of Ninety-one. The man elected to that position of honor was doomed to failure at the earliest opportunity. From entrance until the Senior year the record was unbroken. In sheer desperation, it is said, the office was thrust upon the best man in the class in the hope that the annual tombstone expenses might be reduced, and the charm broken. This plan succeeded, altho' the bell-weather refused to permanently grace the position. Ninety-five seems to have entered with a similar fatality, of enlarged proportions, hanging o'er it. The first harvest of the spectre swept the president, vice president and foot ball captain from the field. At this rate twenty-one good fellows are fated.

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SUBSCRIBERS who fail to receive THE TECHNIC regularly, should promptly report the fact, and immediate attention will be given it.

PROFESSORS Gray, Mees and Ames have been appointed a commmittee of the faculty to arrange a course in electrical engineering, which shall have the same prominence as mechanical or civil engineering, the same to take effect next fall. Interpretation has also been placed upon the conditions for electrical practice in the Sophomore year at the present time, by which much better work can be secured than ever before. The aim is to place the course in electricity on a par with that in any school in the country. The move is fully in keeping with the progressive spirit which has always characterized the management of the Institute, and will be hailed with much pleasure by everyone interested in the school.

* * *

THE faculty of Boston University has voted to permit work on the college paper to count in the course, allowing credit for seven hours per week to the managing editor and two hours per week to each of the assistants. What luxury!

SCIENTIFIC STUDY.

BY PROF. W. A. NOYES.

Many students waste much time at the beginning of scientific study, and others fail to secure satisfactory results from a failure to understand clearly how to go to work. One of the earliest difficulties arises from habits acquired in earlier school work with other subjects. In the study of spelling, of geography, and of history as it is too often taught, there is no close, vital connection between the lesson of one day and that of the day following, and many students acquire the habit of learning each day's lesson by itself, and of very largely dropping the lesson from memory after the recitation is over. An attempt to acquire a knowledge of a scientific subject by such a process is useless. The different parts of science are so connected that no one part can be learned completely by itself, but each must be learned in its relation to many others. Each new fact must not only be learned for itself, but it must be turned over in the mind till the relation to other facts previously acquired is clearly seen and analogies which may exist are discovered. In this way the new fact becomes interwoven in the mind with what is already known, and there gradually grows up a clear, logical view of the science as a whole. Of course, facts once familiar will often grow dim and indistinct, and hence the importance of turning back and freshening the memory whenever old facts which have been forgotten are referred to. It is very important, too, to make use of such aid as can be derived from logical connections and from analogies. No fact should be acquired as a mere act of the memory when it may be acquired by a process of reasoning. In many cases it will be easier at the time to learn by memory than by reasoning, but the result of working like a parrot in trying to acquire a science is disastrous.

All parts of a true science rest upon a solid basis

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All parts of a true science rest upon a solid basis of observed facts. These facts may be the result of direct observation of nature—as is the case with most of the data used by the science of astronomy—or they may have been acquired by means of carefully planned and carefully executed experiments. It is by this latter means, chiefly, that the marvelous advance in all kinds of scientific knowledge and accompanying advance in material prosperity during the present century, have been effected. Many of the ancient philosophers were acute in processes of logical reasoning but most of them held the accurate observation of natural phenomena in little esteem, and very few experiments were conducted by any one. Some of them believed that a process of reasoning alone was sufficient to give a complete knowledge of the universe. So long as this view was held, not even the foundation of any physical science could be laid. For centuries during the dark ages alchemists pursued an opposite course, but one just as little capable of leading to true scientific knowledge. They accepted blindly, on the authority of those who had gone before them, the doctrine of the transmutation of the metals, and they performed a countless number of chemical experiments of every possible description. But the authority in which they believed was fallible, and the experiments were conducted without any logical connection or any systematic purpose to direct them. Some new facts were, of course, discovered, but no real science was developed. The first step in the growth of scientific knowledge came when men learned to discard all authority which does not rest on observed facts. And even in the case of reported observations extreme care was necessary. Thus Lavoisier wrote a century ago that he had not dared to trust any reports of experiments which he had not himself repeated. We can now usually trust the honesty of reported observations, but some discernment in judging of the accuracy of work done is not superfluous. Gradually the accumulation of facts established by careful experiments led to the discovery of general laws and to the development of satisfactory scientific theories. But no scientific theory of any value has been proposed except in close connection with experimental observation.

Now we find certain classes of students who repeat both the mistakes of the ancient philosophers and those of the alchemists. Many students take up the study of scientific theories with an idea that they do not amount to much—that they are only pretty fancies of scientific men, and have very little connection with practical matters. And it is very hard for such students to learn that the theory in reality gives clear expression and logical connection to a vast accumulation of experimental observation, and that even though the theory may in the end prove false, for the time being it renders possible a systematic and scientific arrangement of the facts with which it has to do, and furnishes the incentive and guide for the further development of the scienced. When this is apprehended it will be understood that theories demand the most careful study of any portion of a science. And it will be understood, too, that a theory can not be easily acquired or completely comprehended when it is first presented. It is something which must be turned over and over in the mind and viewed in every possible light in connection with the facts which it is used to explain. A theory is not to be accepted merely on the authority of scietific men or as a result of mere deductive reasoning, but because it furnishes a satisfactory explanation for a large array of natural phenomena.

What has been said thus far refers more especially to the study of text books and of lectures. But no adequate knowledge of a scientific subject can be obtained without a careful personal observation, by the individual, of the facts on which the science is based. Hence, work in laboratories finds an extremely important place in scientific study. There are two distinct objects which it may be sought to attain by laboratory work. In the first place it is necessary for the student to obtain a personal knowledge of the facts with which the science has chiefly to do, and a clear comprehension of the connection between these facts and the theoretical principles lying at the basis of the science. Closely allied to this is a training of the powers of observation and of the ability to interpret phenomena which are seen. An illustration of the perfection which may be attained is given

THE UNITED STATES NAVAL CADET.

BY A. RICE, '93.

The fortunate or unfortunate individual, who has received an appointment to Annapolis, is officially known as a "candidate," and though already quite a hero in his own estimation, is yet far from the coveted goal. With visions of glory and brass buttons he leaves for Annapolis to add one more to "the immortal names that were not born to die." First impressions of that sleepy old town may dampen our hero's ardor; but he recovers from the shock upon entering the beautiful Academy campus, which is really a park of fifty acres, to which fifty more are being added. Shady walks, finely kept lawns with here and there a monument to commemorate the deeds of some naval hero, make the place quite picturesque. The buildings devoted to instruction are scattered about, but too numerous to allow of description here.

The candidate, having been found mentally and physically qualified to become a protector of "Uncle Sam," has to sign articles binding himself to serve eight years from date of entrance. This contract is generally misunderstood. It does not debar a cadet from tendering his resignation whenever he feels disposed to do so. It is not incumbent upon the department to accept his resignation; but seldom are a cadet's services such that he cannot be replaced. Having signed the above mentioned document the candidate becomes a "naval cadet of the fourth class," better known as a "plebe." With a "plebe" one naturally associates "hazing," that time-honored custom which by some is held to be the most efficient remedy for reducing an "undue enlargement of the head."

duties. At six o'clock A. M. "sweet sounds of melody" reach his ear. The bugler begins on the first floor and continues that familiar tune "I-can't-get-'em-up-etc.," until he reaches the fourth, taking but short intermissions occasionally, to catch a fleeting breath. When the last sound on the last floor has died away the officer-of-the-day begins his inspection and woe to him who is still in the land of dreams. Forty-five minutes the cadet is allowed to complete his toilet. The bugler then sounds assembly and the battalion is formed for morning-inspection. While the officer-in-charge makes his inspection the cadet-adjutant reads the conduct report, which is a record of offenses committed during the preceding day. It is astonishing what monstrous crimes naval cadets are guilty of. For instance, one may hear on the conduct-report: Cadet Brown—"Dust on top of wardrobe at 10 A. M. inspection." Cadet Green—"Towel not properly folded at same." Cadet Smith—"Bed thirteen-seventeenths of an inch too far from wall." Even worse crimes are committed by the future admirals of our navy. Demerits are given for these offenses, unless satisfactory written excuses are submitted to the Commandant of Cadets. After inspection, and the reading of conduct-report, the battalion is marched to breakfast, where ham and eggs are discussed for thirty minutes. After breakfast the chaplain offers prayers in the mess-hall. Until 8 o'clock the cadet is given to perform the duties of chamber-maid. Each cadet makes his own bed and takes care of his own property. The two cadets by Liebig, the noted German chemist. At one time Wöhler, another chemist, sent to him a small specimen of a well crystalized organic substance. Liebig at once recognized the substance as allantoïn, which he had analyzed seven years before, but had not seen since. So sure was he, that his confidence was not shaken when it was found that the analysis of the new body did not agree with that which he had previously published. Further than this, he remembered so accurately the little glass in which the original preparation had been preserved that he was able to describe it to his assistant in such a way that he found it among two thousand others. A careful examination showed that the substance was mixed with a small amount of bone-black which had been used in purifiying it. After further purification a new analysis proved the identity with the substance sent by Wöhler.

Very few can attain such an accuracy of observation as was possessed by Liebig, but no student should be satisfied with the results of his laboratory work unless he pays such close attention to the phenomena which he sees as to very greatly increase his powers of observation.

The second object which may be in view in laboratory work is the acquirement of a knowledge of the processes which are used in practical scientific work. These processes may afterwards be used in pure scientific investigations, or in technical work of various kinds. The application of purely scientific methods to techical processes is daily increasing, and more, and more, problems of manufacture and of engineering are being solved by the same methods which are used in scientific laboratories. In this direction the student should first of all seek to exercise the greatest possible care and secure the most accurate results which can be obtained by the methods which he uses. The laboratory gives time and opportunity for the correction of mistakes, and mistakes there are not usually serious in their consequences. When the student goes out into practical life that will be greatly changed. Then the work must often be done in haste and a mistake may carry with it great financial loss, or even more serious consequences. At the same time the student should learn in the laboratory to use his time with economy and so to think about his work and plan it that he will not have long intervals of waiting during his working time.

Finally, with scientific study as with the study of any other subject, the best results can only be obtained when the student brings to his work a live interest and close attention. He must not study in a perfunctory manner because the lesson is set, or because he wishes a passing mark, but with a real desire for a knowledge of the subject. And he must not be afraid to spend, occasionally, a little extra time over a difficult topic. If students, from the beginning, would bring to each lesson the determination to take the time necessary for its complete mastery they would find that in the long run less time would be required than many now spend in doing poor work.

ALUMNI DEPARTMENT.

RECORDING ELECTRIC METERS.

BY FRANK P. COX, '87.

An examination of the various types of registering meters used in this country reveals the fact that there are only two true types of watt-meters which record watt-hours on a dial, and which are equally accurate on direct or alternating currents. These two meters, which divided the first prize of 10,000 francs and a gold medal at the recent meter competition in Paris, France, are the Avon Electric Meter and the Thomson Recording watt-meter. Other meters, as the Edison & Walker for direct currents, and the Shallenberger & Slattery for alternating currents, register in ampere-hours, taking no account of the variation in voltage, and will operate only on the current for which they were designed.

It would be well, perhaps, to briefly consider these four meters before passing on to the two more satisfactory ones first mentioned.

The Edison meter* is simply a jar or cell containing zinc sulphate, in which two plates of zinc are suspended: being, in fact, a zinc volta meter. A very small portion of the current to be measured passes through the cell, the remainder passing through a German silver shunt of low resistance. Knowing the weight of zinc deposited by one ampere in one hour, it is a very simple matter to calculate (from the gain in weight of one plate and the corresponding loss of the other) the number of ampere-hours consumed. The main objections to this class of meter are:

1. Expense of operating. This consists in visiting each meter every month, removing the cell, replacing it with a new one, taking the old cell to the station, removing and drying the plates, carefully weighing them on expensive balances; grinding, polishing and replacing the plates; when the cell is ready for another month's service.

2. Inaccuracy unless very carefully handled. The principal sources of this trouble are error in weighing the plates; error due to variation of temperature (partly compensated for by automatically lighting a lamp in the meter case when the temperature reaches a certain low degree, and extinguishing same when its heat has raised the temperature of the meter to a somewhat higher point); formation of zinc trees short circuiting the plates. Irregularity of deposit causing small particles of zinc to fall from the plates. Concerning this last point the following table may be of interest. An Edison meter may safely be run for

3½ hours per day at	full	capacity.
4½ hours per day at	¾	capacity.
5½ hours per day at	½	capacity.
8½ hours per day at	¼	capacity.
And continually at	⅛	capacity.

3. If the dynamos at the station should reverse their polarity (as sometimes occurs) the meters would not only cease to register for the company, but would actually turn around and deduct what had already been registered.

The Walker meter† is superior to the Edison in many respects. The registration is effected by allowing a ray of light, controlled by an ammeter, to fall upon a strip of photographers' paper which is wound upon a spool at a constant rate. The motion is obtained from clockwork. The light comes from an incandescent lamp placed in front of a screen behind which the paper passes. The light shining through a row of small holes rules the paper as it passes, while a slot in the screen at right angles with these ruled lines is uncovered and almost immediately covered again every hour. The ruled lines are thus crossed at regular intervals by lines representing hours of service. There is a second slot in the screen parallel to the first and covered by an aluminum quadrant, having a slot crossing the one just mentioned. It is through the intersection of these two slots that the light reaches the paper. The aluminum quadrant is mounted as an ammeter needle. Therefore, the position of the point of intersection of the two slots, or practically the ray of light, is controlled by the current. We have, upon development, a curve with amperes as ordinates and

* *Electrical Engineer*, January, 1889, or *Electrical World*, January 5, 1889.

† *Electrical Engineer*, July 30, 1890, and June 3, 1891.

progress. From 4 until 5:30 is drill period. During this time practical instructions of great variety are given. While the "plebe" is taught to "trip the light fantastic," the "youngster" (third-class-man) tries his skill with the foil; the second-class-man pounds a boiler while the first-class-man is probably wasting shell and powder in vain attempts to hit a target in the bay. These exercises change in character every week and thus make this instruction more interesting. Six o'clock in winter and 6:30 in summer is supper hour, 7:30 until 9:30 study hours, at which time every cadet must be in his room and observe silence. At 10 o'clock "taps" sound and the weary student retires to his downy (?) couch. Such is the daily routine from Monday until Saturday, and this routine never changes except on the occasion of a legal holiday or a funeral.

On Saturday the monotony of daily life is somewhat relieved. During the winter recitations take up the time from 8 to 10, drill from 10 to 12. In spring, and until the close of the term in June, the whole period from 8 to 12 is occupied in drill, usually seamanship or great-gun target practice on board the drill ship. Until last year the "Wyoming" was used for this purpose, but she has now retired into private life and will spend the rest of her days as a coal barge. What a sad end! The "Enterprise," a wooden man-of-war of a little more modern type is now used at the Academy. Saturday afternoon he who has behaved himself during the month preceding is allowed to visit the charming city of Annapolis. Unless some "fair attraction" calls him beyond the Academy walls or his palate longs for ice cream and fried oysters, there is nothing to do or see outside of academic limits. Though the gates are often closed to the cadet they are always open to the public, and the culprit who cannot go to see his adored one meets her inside the grounds and, promenading in the beautiful "Lovers' Lane" listening to the rapturous music of the Academy band, forgets his trials and tribulations, in short spends a few hours in heaven. Outside of the regulation amusements dealt out in very small doses by Uncle Sam there are other pleasures provided for the cadets. Frequently amateur theatricals are arranged by the ladies of the yard, which are very much appreciated by the cadets. The officers, of which there are about seventy, give entertainments and receptions at their individual homes, where those who are thus inclined can enjoy social pleasures to their fullest extent. A series of about ten hops is given by the cadets during the winter. At these gatherings the fair ones of Washington, Baltimore and Annapolis are represented in great numbers. On the first or second Friday in June a grand "farewell ball" is given to the graduating class. This is the most brilliant affair of the season and marks the close of the academic year.

Such is the life of a naval cadet in shore-quarters, but even before he becomes well acquainted with his duties on land more novel and often unpleasanter duties at sea await him. The "plebe" who enters in May has to embark on the practice cruise in June. To the uninitiated youth who has probably never seen a greater expanse of water than is contained in his mother's wash-tub a practice cruise is a terrible experience. To climb one hundred and fifty feet, holding on to the "ragged edge of despair" with nothing but sky above and water beneath is something poor "plebe" did not bargain for; and when Neptune demands a tribute for his little fishes in the sea our hero begins to think how much nicer it was at home. With more experience life at sea assumes a different aspect and becomes to many a one very attractive.

hours as abscissæ. An integration of this curve gives the ampere hours consumed. The incandescent lamp mentioned as the source of light is automatically cut out of circuit when no lamps are in use, but immediately re-lights when the first lamp is turned on. The act of extinguishing the lamp also stops the clock, which starts again when the lamp re-lights. One noticeable feature of the meter is the self-winding clock. Every five seconds an electro magnet is cut in series with the lamp, and, drawing in its armature, a gear of the winding mechanism is advanced one tooth.

It is evident that a great deal of thought has been expended on every detail of this meter, and there is no doubt that it is extremely accurate when in good order. There are still, however, several decided objections to be overcome. They are:

1. The meter does not record upon a dial but must be visited every month; the paper rolls must be collected, carried back to the station, developed, and the curves integrated. All this takes time and costs money. The mechanism is complicated and does not seem durable. It is an easy matter to get the meter out of adjustment, but quite a difficult one to readjust it.

2. Acid fumes, etc., will destroy the film, leaving no record of the month's work.

3. It is necessary to burn one lamp inside the meter in order to make a record. Thus, when only one lamp is being used, it costs as much to make the record as it does to light the room.

4. If the lamp should burn out, there would be no record made, or if the roll of paper were accidentally exposed to light the record would be destroyed.

It may be a very fair laboratory meter but it is not capable of withstanding the abuses a meter receives in commercial service.

Coming now to the Shallenberger* and Slattery meters, we find an altogether new type. This is the motor meter where the current to be measured drives a small motor, the speed being proportional to the power used. The number of revolutions made by the motor is registered upon a dial so that in visiting the meter it is only necessary to note the indication of the dial and pass on to the next meter without even removing the cover. The Shallenberger and Slattery meters are similar in theory and may be considered together. The motor consists of small iron rings mounted on a shaft and rotating inside a series of punched copper washers, which are in turn surrounded by a coil of wire carrying the current to be measured. The current in the coil induces currents in the ring and also in the washers which may be considered as a short circuited secondary. The resulting rotation is evidently zero when the planes of the coil and of the secondary coincide; attains a maximum at 45° and again reduces to zero at 90°. The meter is calibrated by shifting the position of the secondary. In the Shallenberger meter there is but one iron ring. In the old style Slattery there were five which number has been reduced to two in the more recent meters. These rings are mounted on a light copper drum.

The speed of this motor would be very high unless loaded in some manner and it is evident that to secure accuracy the load must decrease as the torque decreases. Mr. Shallenberger, claiming that the torque was proportional to the square of the current, mounted four aluminium fans on the shaft of his meter so that the load (or drag as it is usually called) might be proportional to the square of the speed.

If this were true the meter would undoubtedly be correct on all loads except the light ones, where friction would introduce an error. But experiment indicates that the torque is proportional to a somewhat lower power than the square of the current, and this proportion is not constant, decreasing with the higher loads. This effect is principally due to the saturation of the iron ring, although hysteresis may have a noticeable influence. The meter may, in general, be expected to run slow on light and full loads, and fast on medium loads, the average being a rough approximation of the current consumed. It should be noted, however, that the meter is not adapted to circuits having an inductive resistance, for here the current is no measure of the power.

Mr. Slattery noticed the error at high speeds in

* *Electrical Engineer*, September, 1888.

the Shallenberger meter and embodied in his meter a very ingenious method of compensation. Each fan is made in two pieces, the first firmly attached to the shaft, the second pivoted and free to move over the first. A small weight, acting as a centrifugal governor, closes the two pieces of a fan (one over the other) at the higher speeds. Less surface being exposed there results less resistance to rotation and the rate of the meter is increased. The difference between this and the old style Slattery is quite marked on the high readings, the low ones being practically the same.

The more recent Slattery meters show still another departure. First, the fans were replaced by a corrugated aluminium disc which rotated between the poles of four permanent magnets and a pressure coil was added so that the variation of potential in the mains is not neglected. This coil is wound over the current coil and acts in the same manner except that the variation of torque depends upon the potential. In the latest type of meter, the aluminium disc is replaced by a copper tube surrounding a cylinder of soft iron. The number of magnets has been reduced to two and these are turned on their sides. The path of the magnetic lines is from one magnet pole through the tube through the soft iron back again through the tube to the other magnet pole. A method of raising the shafts from the jewel has been added and numerous improvements made in the details of the meter.

The Avon meter* can not properly be classed with any of the preceding meters. It is a clock-work meter and must be wound every month. It consists of two pendulums adjusted until their periods of oscillation are the same. At the lower extremity of one of these pendulums is a bobbin of fine wire which oscillates through the center of a coil of coarse wire carrying the current to be measured. This fine-wire bobbin, in series with a resistance, is connected across the mains. In some meters this arrangement is replaced by a permanent magnet, oscillating above a coil of wire carrying the current. The action is the same in either case except that the latter meter can not be used on alternating currents. The two pendulums are connected by a differential gear and when there is no current being used, their periods being the same, the gear merely turns on its axis and there is no motion of translation. When, however, a current flows through the coarse wire coil this pendulum is accelerated and, the periods of the two pendulums being no longer equal, the gear has a motion of translation as well as of rotation.

This motion of translation, or the difference in period of the pendulums, is registered upon a dial and is a measure of the power passing. The dial reading multiplied by a decimal constant gives the number of watt, or ampere-hours, consumed.

The advantage of this meter over the Walker, is that it records in watt-hours as compared to ampere hours; it is equally accurate on direct or alternating currents; there is not the expense of removing, developing and integrating a curve; and it can be read by the consumer as well as the station man. The disadvantages are: 1. That it must be wound, though a self-winding mechanism could be added if desired. 2. Cheap clocks can not be relied upon and fine ones make the first cost too high. This second objection, of course, holds with the Walker meter. The Thomson meter† is materially different from any of those mentioned. It is in reality a small motor without iron. Unlike the majority of motors only a very small fraction of an ampere passes through the armature, the main current flowing through the field coils. Near the lower extremity of the shaft is mounted a copper disc which rotates between the poles of three permanent magnets. At the upper end of the shaft is a worm which meshes in the first gear of the dial. Each revolution of the shaft is recorded on the dial of direct reading meters as one watt-hour. The high capacity meters have a simple constant as 2, 3 or 4, the necessity of which will be explained later. The watt-hour is undoubtedly the most desirable unit to adopt. It is directly comparable with gas since 10,000 watt-hours of electricity give about the same illumination as 1,000 feet of gas. The theory of the meter is

* *Electrical World*, July 16, 1887.

† *Electrical Engineer*, November 5, 1890 and June 17, 1891.

very simple and gives evidence that the meter must be correct at all loads. Let
N_f=Number of turns in the field.
N_a=Number of turns in $\frac{1}{2}$ the armature.
N_s=Number of turns in the extra shunt field.
C_f=Current in the field.
C_a=Current in the armature.
R_a=Armature resistance.
R_s=Extra shunt field resistance.
R_x=Additional resistance in series with armature.
R_D=Resistance of the disc.
C_D=Current in disc.
E_D=E. M. F. generated in disc.
E=Potential of mains.
M=Magnet strength.
S=Revolutions per minute.
T=Torque.
D=Magnetic drag.
F=Drag due to friction.
K, K', K'', etc.=Constants.

The maximum speed of these meters is quite low. When the capacity of the meter would require a higher speed, a simple constant is added and the rate per lamp reduced in the same ratio. To avoid unnecessary complication, the meter under consideration will be taken as a direct reading meter. Then

$$C_a = \frac{E}{R_a + R_s + R_x} \quad \text{(I)}$$

for the speed is so low and the field so weak that the counter electromotive force is practically zero.

$$T \propto C_a\,(N_a + N_s)\;C_f\,N_f$$
$$T = K\,C_a\,(N_a + N_s)\;C_f\,N_f \quad \text{(II)}$$
$$D \propto C_D\;M$$

But, $C_D = \dfrac{E_D}{R_D}$

$$E_D \propto S\;M$$
$$C_D = \frac{S\;M\;K'}{R_D}$$

Substituting this value in (II), we obtain

$$D \propto \frac{S\,M^2\,K'}{R_D}$$

and since the resistance of the disc is constant, we have after combining all constants

$$D = M^2\;S\;K'' \quad \text{(III)}$$

Since the total resistance to rotation consists of the magnetic drag, plus the friction, we have at some one point

$T\;K''' = D + F$, or, from (II) and (III)

$$K\,C_a\,(N_a + N_s)\;C_f\;N_f\;K''' = M^2\;S\;K'' + F.$$

The object of the extra shunt field is to balance the effect of friction. In the smaller capacities of meters, where the number of turns is comparatively large, this extra field is not necessary, as the armature current flowing through the field just balances friction. We may, therefore, drop N_s and F from the equation without introducing any error, and combining constants, we obtain

$$C_a\;N_a\;C_f\;N_f = M^2\;S\;K^{IV} \quad \text{(IV)}$$

Combining (I) and (IV),

$$\frac{E\;C_f\;N_a\;N_f}{R_a + R_x + R_s} = M^2\;S\;K^{IV},$$

Or,

$$\frac{S}{E\;C_f} = \frac{N_a\;N_f}{K^{IV}\;M^2\,(R_a + R_x + R_s)}$$

All the terms in the second member of this equation are constant and the meter curve is evidently a straight line. The ratio of the speed to the watts consumed is constant and the meter must be correct at all loads.

In closing, it may not be out of place to mention the correct method of plotting meter curves. It is nothing unusual to see a meter curve plotted with watts as abscissæ and meter readings as ordinates. The result, with a perfect meter, would be a line crossing the axes at their intersection and making an angle of 45°. This method really shows very few of the characteristics of a meter. It merely shows where the meter is incorrect without being any measure of the amount of error. A far better method is to plot watts as abscissæ and for ordinates, not meter readings, but the ratio of meter reading to true watt-hours. By this method a perfect meter gives a horizontal straight line and any error is read off in per cent. fast or slow.

It has not been the intention in this article to give an accurate description of any of the meters mentioned, but rather to point out their characteristics and refer the reader to articles in the electrical journals which will supply the missing information. With the exception of the Slattery meter (of which no description could be found), this has been done in every case.

There are many meters which have not been mentioned at all, partly because they are not used to any great extent in this country, and partly because this paper has already exceeded the limits mentioned by the editors of THE TECHNIC. The principal ones are The Forbes Meter, *Electrical Engineer*, November, 1887; Geyer Bristol Meter, *Electrical Engineer*, December, 1888 and November 19, 1890; Wright Ferranti Meter, *Electrical Engineer*, June 18, 1890.

VARIATION OF LATITUDE.

BY JOHN A. PARKHURST.

The vexed question of the existence of a variation in terrestrial latitudes seems in a fair way to receive a definite answer in the affimative. As this would imply a shifting of the earth's axis of rotation with respect to the sphere, we would at first sight be inclined to say—impossible, or at least very improbable. But more than a century ago the great mathematician, Euler, pointed out the probability of a variation and assigned a theoretical period, for reasons which now seem to be, in the main, correct. Prof. Newcomb lends his sanction to the same statement, as does also Prof. H. Bruns, of Leipsig. More than this, the renowned Prof. C. H. Darwin, states that it is a dynamic possibility that the axis of a planet should change as much as 30°, as is supposed to be the case with the moon.

Variations in the values of the best determined terrestrial latitudes have long been recognized and many efforts have been made to account for them by some general law; but until lately no explanation has been able to stand criticism. A progressive secular change has been suspected and an argument in its support has been deduced from the Great Pyramid, compared with modern latitudes. Confirmation of this was supposed to be found in a decrease in the latitude of Greenwich, England, of one or two seconds of arc since 1750, but Prof. Anwers, of Berlin, has confuted this supposition by a new reduction of the observations of 1750. An annual change has been proposed as another explanation. It is true that when observations of the same stars are continued throughout the year, the differences show an annual cycle, but this can generally be accounted for by changes of temperature from season to season, and especially from day to night if daytime observations are made. Prof. Simon Newcomb has lately shown this to be true in the case of the remarkable series of observations made at Washington, on the star Vega, extending from 1862 to 1867; and Dr. Van Hennekeler's researches based on the Leyden observations confirm this statement.

The true solution of the problem seems to have been made by Prof. S. C. Chandler, of Harvard College Observatory. He finds a period of 427 days for the variation. Prof. Newcomb shows the relation of this period to Euler's period of ten months already mentioned. Let me quote his own words:* "When the differential equations of the earth's rotation are integrated, there appear two arbitrary constants, representing the position at any assigned epoch of the axis of rotation relative to that of figure. Theory then shows that the axis of rotation will revolve round that of figure in a period of 306 days, in a direction from west to east. * * * * * * * * The question now arises whether Mr. Chandler's results can be reconciled with dynamic theory. I answer that it can, because the theory which assigns 306 days as the time of revolution is based on the hypothesis that the earth is an absolutely rigid body. But, as a matter of fact, the fluidity of the ocean plays an important part in the phenomenon, as does also the elasticity of the earth. The combined effect of this fluidity and elasticity is that if the axis of rotation is displaced by a certain amount, the axis of figure will, by the changed action of the centrifugal force, be moved towards coincidence with the new axis of rotation. The result is, that the motion of the latter will be diminished in a corresponding ratio, and thus the time of revolution will be lengthened."

*Astronomical Journal; Vol. X, page 81.

Prof. Chandler finds that the variations can be accounted for by a revolution of the earth's pole in 427 days, from west to east, with a radius of thirty feet measured at the earth's surface; and that the direction of the axis of figure from the axis of rotation lay towards the meridian of Greenwich about the beginning of the year 1890, consequently the latitude of Greenwich was a minimum at that time. The remarkable feature of this discovery lies in the fact that it is confirmed by an immense number of the best latitude observations ever made, taken at widely different times and places. As examples may be mentioned:

Bradley's observations at Greenwich	1750–62
Bessel's observations at Königsberg	1820–44
Struve's observations at Dorpat	1822–38
Greenwich observations	1837–75

Simultaneous observations at Washington, Leyden, Pulcova and Melbourne, 1863-67, also at Cambridge and Berlin, 1884-85, and finally at Berlin, Prague and Strassburg from October, 1889, till the present time.

With such an array of authorities supporting him, Prof. Chandler need have little fear that adverse criticism will drive him from his position, though it is quite likely that more accurate values will be obtained for the period and amplitude of the variatiou.

CHEMISTRY IN THE IRON AND STEEL INDUSTRY.

BY W. B. WILEY, '89.

Comparatively few people know much that is definite concerning the duties of a chemist for a steel plant. He is expected to report upon two classes of products. First, the raw materials (if there is really such a thing), and, second, upon the finished product. At the Illinois Steel Company's Milwaukee Works, with which I am connected, and which has no steel mill, the laboratory is expected to analyze iron ores, coke, limestone and various kinds of flux, mill and spiegel cinders and upon the finished pig iron, together with occasional samples of merchant bar from the bar mills. Ordinarily in iron ores, metallic iron, phosphorous, silica and moisture are determined, and occasionally the manganese, but when ores are received for the first time complete analyses are made. The results must be accurate, for upon them is based the price paid for the ore and also the calculations of furnace burden; and in almost every case we must "check" with the chemists employed by the mines. Cokes are analyzed for sulphur and ash, and once a month a complete analysis of the ash is made. Silica only is determined ordinarily in limestone, although complete analyses are sometimes required. All cinders are treated like ores, except that the manganese in spiegel cinder is always accurately determined. In sampling any of the foregoing substances care is taken that the sample shall exactly represent the lot received; this sample, varying in size from 250 to 1,300 or 1,500 pounds, except in the case of a coke sample, is crushed and by continually quartering and pounding is reduced to about a pound and a half or two pounds of a powder as fine as flour which is dried at 100° C and analyzed as stated above. The weight of a sample of coke is rarely equal to fifty pounds and a small fragment of each piece of the sample is taken and these are then reduced to the fineness of flour. The results of all these analyses are reported to the superintendent of the furnaces and upon them he bases his calculations as to the amount of each substance he must use to produce a required variety of iron. When the pig iron is run from the furnace a sample is taken from each cast and sent to the laboratory where drillings are taken from the broken surface of the pig; these are then analyzed, in the case of foundry and mill irons, for silica and sulphur in each cast. Once a week a day's iron is averaged and phosphorous determined, and twice weekly an average day's run is analyzed for manganese. These results, together with the analysis of the furnace slag for salica and alumina, show the furnace men whether or not the furnace is working properly. When Bessemer pig iron is being made (i. e., an iron carrying a small percentage of phosphorous and manganese), these elements must be more frequently determined, as often sometimes as in every cast.

A comparison is made monthly between the different laboratories of the Illinois Steel Company, and there is considerable rivalry to see which will turn out the most work at the least expense. This laboratory generally makes a good showing, considering the fact that no steel is made here; for where there is a steel mill the number of carbon and sulphur determinations increases the grand total without a proportionate increase in the running expenses. During the month of July 1,134 determinations, in August 1,084, and in September 1,027, were made here.

An iron chemist must be accurate and have rapidity; he *must* learn the former in schools, the latter is only acquired in actual commercial work.

CHEMICAL LABORATORY, MILWAUKEE WORKS, ILLINOIS STEEL COMPANY.

NOTES.

Mr. V. J. Gillett, '91, visited in the city during the holidays.

Mr. H. H. Holding, '89, made a brief visit in the city recently.

Mr. Edward G. Waters, '88, came home from Pittsburg to spend the holidays.

Mr. Barton Shover, '90, and Mr. Jos. Harper, '91, visited here during the vacation.

Mr. A. L. Hupe, '91, spent the holidays with his class-mate, Mr. Balsley, in Lynn, Mass.

Mr. Eli Elder, '90, assistant engineer of the Northern Pacific R. R., is now visiting his home in Kalamazoo, Mich.

Mr. Alonzo Hammond, '89, city engineer of Frankfort, paid the R. P. I. a business call in regard to his profession recently.

Mr. Theo. L. Condron, '90, has finished work with Mr. Cole, of Chicago, and is now visiting his home in Washington, D. C.

Mr. Wm. Boehm, '91, passed through the city about two weeks ago, on his way to Cornell, where he intends taking a post graduate course in civil engineering.

Mr. Wm. H. Schrader, who recently obtained the degree D. Ph., at Glasgow, Scotland, has become Professor of Physics in the State University at Columbia, Mo.

Mr. John G. Mack, '87, of the firm of Jones & Mack, Cincinnati, recently returned to that place after a visit of two or more weeks here partly on account of sickness.

Mr. Herschel Harris, '91, has broken connections with the Morrison Bridge Co., Chicago, and is now assistant draughtsman for the Terra Cotta Works, Terra Cotta, McHenry county, Illinois.

Mr. H. St. Clair Putnam, '86, has severed his connections with the Thomson-Houston Electric Light Company, and is now located at Joplin, Mo., as manager of the Southwestern Electric Light and Power Company.

Mr. J. T. Wilkin, '86, Connersville, who was appointed chairman of the Indiana Fuel Board, made a short visit recently to "Rose" for the purpose of consulting Prof. Noyes in regard to subjects pertaining to the above connection.

I made her a verse
  One bright summer's day.
But I could not do worse
Than to make her a verse
For with words that were terse
  She sent me away—
I made her averse
  One bright summer's day. —*Ex.*

THE SHOP FIRE.

The first serious misfortune that has befallen the Institute in the loss or destruction of property since its opening, was the partial burning of the shops in the early morning of Thursday, the 14th inst. Even this should hardly be characterized as a great misfortune, for it practically amounts to little more than a temporary inconvenience. The fire did not prove a "relentless, devouring agent," for the larger part of the building was spared. The valuable machinery was not "irretrievably damaged" nor was the power plant "annihilated." In brief, the loss was wonderfully small, considering what there was to be destroyed, and as it is all completely covered by insurance the practical serious result will be a brief suspension of shop practice for the students. The story of the fire is as follows:

About 4:30 A. M. the night watchman, upon returning from the rear of the boilers to the front, noticed a peculiar light coming from the court between the main building and the boiler room. Examination disclosed that the "dust flue" leading from the wood room to the "dust" room, was on fire. The small boiler room hose was turned on immediately, but owing to the hurry and excitement the pipe was in some way bursted. The watchman and his helper at once rushed up stairs and attempted to fight the fire by pouring the water contained in the fire buckets into the "dust flue." This was found impracticable on account of the close quarters in which the blower is placed. The next attempt was to fight from below by throwing water from the ground. About this time an alarm was sounded by the C. & E. I. switch engines, and No. 5 fire company was soon on the ground. The fire could then have been extinguished very easily but for the unfortunate bursting of the hose. While a new hose was being laid the flames gained tremendous headway, and when the stream was again put in play the whole roof was ablaze, the tower serving as an immense chimney. The entire fire department came to the rescue, however, and soon the deluge of water brought the flames under control, confining them to the north end of the building. By daylight the fire was out. The morning was intensely cold, and soon all the roof timbers, the floors and the machine shop equipment were covered with ice. Indeed, so low was the temperature that the firemen suffered at their work. They did well, though, all things considered, and undoubtedly credit should be given them for preventing the "temporary inconvenience" from becoming a terrible calamity.

A daylight survey developed a surprise for all, for it was soon discovered that the fire, apparently so devouring, had been a remarkably fortunate one. The loss, a hasty inspection showed, was confined to the destruction of the roof entire (altho' this, happily, was not so completly consumed as to fall, except at the north end), the lumber stock on the second floor, a big lot of wood work done by students and stored in the tower, the greater part of the electrical equipment placed in the extreme north end of the shop, and the thorough drenching of everything in the structure.

It was thought at first that the falling floor at the north end had injured the Westinghouse compound engine and ruined the Westinghouse alternating dynamo. Subsequent investigation has shown the engine to be all right, and it is possible that the dynamo is practically uninjured. The switch board, with its transformers, ammeters, etc., and the small exciter for the alternator, are completely wrecked so far as now (Friday P. M.) known. The Perret direct current dynamo has probably suffered only to the extent of a soaking. The Brown engine is uninjured.

Estimates on the losses are, as yet, very inaccurate, of necessity. A thorough investigation only, which will be made when the insurance adjusters come, can show what it is. The guesses variously made are from $8,000 to $12,000. A rough estimate made by the Clift Williams Co., placed the injury to the building at $4,500. Prof. Mees also roughly estimates the electrical loss at about $1,500. This does not include either of the large dynamos, and only places a two-thirds loss on all the other apparatus. Should this cover all of it, the $5,500 equipment comes out well. Prof. Brown's estimates on the machinery, stock, etc., had not been completed at the time of this report. The insurance, which will cover everything, is divided as follows:

	Building.	Machinery and Materials.	Engines and Boilers.
J. D. Bigelow, Agent—			
New York Home	...	$3,700	$1,300
Jacob Early, Agent—			
Hanover	...	9,700	300
Firemen's Fund	$5,000	2,400	100
Norwich Union	5,000	2,400	100
	$10,000	$18,200	$2,800
Total			$30,000

Reconstruction will be pushed with all possible haste, and at the outside limit but one month will be required to have the entire plant in excellent condition. In the meantime a re-arranged schedule will be followed, according to which all the classes will work full time, doing extra work in laboratories, drawing, etc., for which compensation will subsequently be made in shop time. The classes will be affected as follows:

Seniors—Machine design, and electrical and physical laboratory work additional.

Juniors—Two hours electricity and four hours drawing additional.

Sophomores—Three hours drawing, two hours chemical laboratory and one chemistry lecture additional.

Freshmen—Two hours drawing and one chemistry lecture additional, nine hours to be spent assisting at the shops if needed, or otherwise given up to visiting the various industrial institutions of the city.

The Juniors' extra electricity will be lectures on "Potential," by Prof. Hathaway. These lectures the Seniors will probably take also.

HERE AND THERE.

SENIOR THESES.

The members of the Senior class have been granted considerable latitude in the selection of their thesis subjects, and also in the arrangement of their sections for work, with the result that at this early date a fairly accurate forecast of the annual commencement programme can be given. This is herewith presented, the only comment necessary being the suggestion that a number of changes may be made previous to the actual commencement of thesis work the last week in February:

LAUX, EHRSAM AND WICKS—
Construction and Test of a 4,000 Watt compound-wound dynamo, designed by Professors Gray, Mees, and Brown. The dynamo will be built according to plans made by S. S. Wales, p. g.

OGLESBY AND SPERRY—
Test of Terre Haute House lighting plant.

BIXBY AND WOOD—
Effect of temperature on the strength of materials.

WICKAM—
Test of Perret Dynamo.

WILSON—
Measurement of Hysterisis.

YOUNG, PUTNAM AND FRANK—
Test of Davenport, Iowa, electric lighting plant.

FOGARTY, FOLSOM, DIETRICH AND LAYMAN—
1st. Series of tests of Westinghouse compound steam engine.
2d. Seris of testes of Clerk gas engine.

HUSSEY—
Undecided.

WETHERBEE AND ROCK—
Boiler test in R. P. I. shops.

DAVIS AND BOYLES—
Experiments on Westinghouse alternating dynamo.

OTT AND TIPPY—
Multiphase currents.

TINSLEY AND ROSE—
Bridge deflections due to passage of trains.

As has heretofore been the custom each member of the class will also be required to submit a thesis drawing. This drawing, however simple it may be, has always proven the bugbear of the Senior year. Anticipating the trials and tribulations attendant upon neglect of the first oportunity to get it out of the way, several "ambitious" '92's put in a large part of the holiday vacation endeavoring—in some instances successfully, in others not—to finish theirs up. With the remainder of the class, experience will likely prove a repetition of the old, old story.

FROM THE YANKTON AGENCY.

The following extract is from a letter addressed to Dr. Mees from H. H. Meadows, a popular member of the original class of '94: "You may perhaps wonder what I am doing in South Dakota. In fact I only remained in Montana about a month before we were transferred to this Reservation. My uncle is a U. S. Special Agent to allot lands to the Indians, and I run, or rather retrace, the lines, do some platting and fill up the rest of the time 'cussing' the Indians. My outfit consists of two Indian chain-carriers, an Indian teamster and half French interpreter. We usually employ three trains and get our camping outfit from Ft. Randall. I have been camping out from the 10th of May to December 20th, but now am doing office work. I enjoy roughing it very much but expect to be in the Poly next year."

ATHLETIC.

The athletic ball was set rolling again after the holidays by a called meeting of the directors of the Association, held in the president's office, Friday, the 8th inst. The object of the meeting was to provide for the election of a successor to Mr. Teller as secretary of the Association. This office belonging to the Sophomores, that class was requested by the board to nominate two candidates on or before Wednesday, the 13th inst., and the general election was then set for Friday, the 15th. It was also resolved by the board at this meeting to push the collection of dues immediately.

The maid expects her beau to-night,
And fills her stove with anthracite,
Because the air is raw and damp,
But quite forgets to fill the lamp. —*Bema.*

LOCALISMS.

Long and Dent, '93, have withdrawn.

McGregor, '93, spent his vacation in Washington, D. C.

The average Poly has demonstrated that he is a good skater.

It seems natural to have Dave and Carl McCulloch back again.

Lamb, '95, has returned home to have his throat and eyes treated.

Dr. Eddy lectured before the city teachers, Saturday, upon the moon.

The latest topical song closes with the refrain: "How McGregor missed the train."

Eddy, '95, met with a slight accident during vacation. The old, old story of the buzz saw.

Mr. McCormick received a Christmas present of a very fine easy chair from the Freshman class.

Mr. McCormick has found teaching a much more pleasant vocation than he imagined it would be.

The clear, cool weather, together with the good skating, had a magic effect on several cases of the grip.

Hood, '95, who was obliged to return home for a few days last week on account of sickness, is back again.

The Juniors dislike giving up the study of German, even for a short time. French has been substituted.

There were only six professors and the janitor in the room during Sophomore examination in mathematics.

Taylor, the class photographer of '95, took an excellent picture of his class a short time before Christmas vacation.

E. J. Lake, formerly of '94, passed the greater portion of his vacation here. He is taking a special course in architecture at the Illinois State University, and he was lavish in praise of that institution. He reports that they take particular pride in the condition of athletics over there.

"The pipe line's froze."

The Seniors are talking class pins.

Prof. Mees spent his vacation at Columbus, O.

Wanted! One hundred, as our next term shop-mark.

Who said Davis, '92, couldn't cut a grape vine on ice?

Aten, Thompson and Boatman have entered Purdue.

Scientific German again has the Seniors in contortions.

Prof. Brown and wife were at Cadiz, O., during vacation.

Matthews, recently of '92, is thinking of entering Purdue.

Experience has proven bicycles to be fairly good snow wheels.

Paul White, '95, spent his vacation with classmates, at Louisville.

The friends of Castle, formerly '95, can find him at Buntin's drug store.

Mr. R. L. McCormick passed his vacation at his home in Sellersburg, Ind.

Darst, '95, was called home to Eureka, Illinois, on account of the fatal illness of his sister.

J. R. Leighty, formerly '92, is located with the Chicago and Northwestern Railroad, in Chicago.

Mundy, '95, entertained the "Nursery" combine one evening during vacation, at his home in Louisville.

Dent, who was taking a special course, left here at the close of last term to enter the Alabama Polytechic.

Odell's bicycle was shipped to Salt Lake City. He has gone to Leland Standford, Jr., and entered Sophomore.

It is not many days since a communication was received at the Poly addressed to "The Orphan's Trade School." We appreciate a humorous effort of that character without investigating its source.

Johnson, '93, spent a large part of his vacation in bed, suffering with the fashionable disease, "La Grippe."

The addition of some good daily newspaper to the reading-room subscription list would be a popular move.

Of the Seniors, Laux, Ehrsam, Dietrich, Rock, and Sperry, besides the Terre Haute boys, spent the vacation here.

C. V. Kerr, Prof. of Engineering at Arkansas State Agricultural College, was a recent visitor at Rose Polytechnic.

Andrews, '94, lengthened his vacation one week in order to commence the present term unembarrassed by the mumps.

Mendenhall, '94, remained at his home in Washington, D. C., a few days after vacation to avoid returning with his share of the grip.

Prof. Brown will permit Seniors to do thesis work on shop time, when the apparatus made can be made use of for class work subsequently.

The unusual features of the grades of last term were three marks above 90 in the Senior class, and a shop mark of 100 for each of four Freshmen.

As a result of the recent encounter, the losses sustained by the different classes were as follows: Juniors, three; Sophomores, six; Freshman, five.

Mr. Hartman, formerly engineer at the Polytechnic Shops, and at present connected with the Westinghouse Co., visited the Institute last week.

Prest. Eddy attended the meetings of the Indiana College Association, and Indiana Academy of Science, held at Indianapolis, Dec. 28th–31st.

Tippy is the only member of the Senior class who did not appear at the commencement of the term. He was detained, owing to the illness of his father.

A few of the students who travel on the C. & E. I. R. R. delight in relating, each in his own peculiar dash of oratory, the number and character of wrecks in which they played an important part.

It was only a canard that the Junior class had an iron-clad agreement to withdraw in a body should any member fail in the Christmas exam inations.

H. D. Kramm, from the University of Illinois, is the most recent member of the Sophomore class. He entered at the commencement of the present term.

Irving Usuer, whom '92 men will recall as one of the "Chicago triumvirate" in their Sophomore year, is now with the Chicago Electric Manufacturing Company.

T. S. Baily, from Carlton College, Northfield, Minn., and E. R. Burtis, from Kansas State Agricultural College, Manhattan, Kan., have entered the Freshman class.

Professors Hathaway and Noyes read brief papers at the Seventh Annual Meeting of the Indiana Academy of Science, held at Indianapolis, Dec. 30th and 31st.

The members of the entire Sophomore class are going to stand by each other in German. That is the only subject which brings both sections together for all recitations.

Mr. T. C. Buntin, father of R. H. Buntin, formerly of '93, died at his home on East Main street, the morning of January 11, 1892. Roll has the sympathy of the entire school.

Those who are inclined to doubt that Terre Haute possesses certain attractive points are referred to alumni and other former students who return here to spend the holidays.

Prof. Mees is delivering his second course of lectures on practical electricity to the Society of Stationary Engineers. The sixth of the present series will be delivered Friday evening.

In good faith we were recently informed that the exclamation point is fast superceding the factorial sign, owing to the abundance of exclamations in fully equipped printing offices.

Sophomores are receiving instruction on the subject of determinants from Prof. Hathaway, who has prepared a list of notes to be used in connection with his lectures on that subject.

Now that the weather is unfavorable for outdoor athletics, several of the students devote a portion of their time to fencing. Perhaps it is not generally known that there are several Polys well up in the art.

Freshman class-meeting, held January 7th, elected Ashworth, president; Anderson, vice-president; Light, foot-ball captain, to fill the vacancies left by Lamb, excused on leave of absence, Breyfogle and Hartman.

The Poly who has appreciated the privileges o this institution for one year is supposed to know something of the art of skating, so that it is usually left to the fourth class men to entertain the public in their wild, reckless, far-reaching attempts to acquire that art.

It is noticable what a short time is taken by the average Poly from the commencement of a new term until he has adapted himself to its necessities, and appears almost the same as though he had known no interruption; yet not entirely so because of the few faces which are regretfully missed.

By a letter recently received from J. A. Parra, formerly of '94, his many friends here are pleased to know that he is making satisfactory progress at the Colorado School of Mines, Golden, Colo. Much of his time during his recent vacation was devoted to practical study of mining operations in that locality.

The picture of the Sophomore class, taken a week before the close of last term, is one of which the members are justly proud. The several members of the faculty add much to the appearance of the group, and also suggest the idea of that close relation between the faculty and '94 during examination in mathematics.

Professors Gray, Mees and Brown, have been working for some time on the plans of a new generator to be used for experimental purposes in the Electrical Laboratory. The drawings have been completed by Wales, '91, and the machine is to be constructed in the shops this year. A full description will appear in THE TECHNIC as soon as the machine is well under way.

Prof. Howe could not attend the Indiana College Association meetings, held in Indianapolis during the holidays, and so his paper on "The Education Required for the Civil Engineer of Today," was read by Prof. Kirchner.

John Hudson Peck, L.L.D., President of the Board of Trustees and Faculty, of Rensselaer Polytechnic Institute, visited Rose Polytechnic a few weeks ago. The object of his visit was to observe the methods of operation in the Mechanical and Electrical Departments.

The following item taken from the *Sequoria*, a publication of Leland Stanford, Jr., University, is self-explanatory: "Our record breakers are fast coming to the front. Among the most prominent is Cantelopus L. Patterson, time between door of room and dining table 2 6-13 sec."

At a recent meeting of the Freshman class Ed Light was elected Captain of the Freshman foot-ball team to succeed Hartman; Light has already shown himself to be one of the players of the school and out of the good material he has to work on is likely to develop a strong class team.

There is talk among the foot-ball enthusiasts of arranging for another series of games to be played as soon as the weather will allow. By picking men from the school without regard to class, two very good teams might be formed and the practice afforded would he right in the line of what is needed for a school team next fall. The idea of playing foot-ball in the winter and spring will no doubt be laughed at in the other colleges, but if we thereby gain a point for foot-ball we can afford to stand their jeers.

Indiana University has already elected its base-ball managing committee, and has taken steps placing its nine on a strong footing. They say that nothing less than the pennant will satisfy this year. This may well be taken home as a strong tip to our nine to get ready for a harder contest than it had last year. The board of directors should lose no more time in appointing the committee; after that the training and picking of men, and the ways and means of supporting the team can be pushed ahead.

The laborious work of stimulating the Poly goes bravely on. In future an average mark of 40% on each subject will be required at each semi-annual examination, and a mark of 60% will be necessary to pass a condition.

A few days ago one of the local Polys, who drives into town each day, permitted his horse to give him the slip, and was obliged to return home accompanined by original thought. The rise in temperature at that time was probably owing to a few unseasonable remarks which fell by the wayside.

The announcement that was to make the "Seniors' hair stand on end," has been made. It is to the effect that the faculty reserves the right to examine graduates in the work of the entire course before granting a degree. Horrors upon horrors! Picture the agony an enforcement of this "reserve" rule would cause.

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Professor—"How many kinds of salts are there?"

Sophomore—"Three. Soluble, insoluble, and neither soluable nor insoluable."

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Prof. ——, Coates College.—"Miss R., please give some examples of words with the suffix, "hood."

Miss R.—"Childhood, womanhood, ——."

Class Chorus.—"Ernest Hood!"

—

Mr. Newman—"What is that unearthly disturbance on the floor above?"

Mr. Oldboy—"A Sophomore has made a break in Dutch and the class is contributing its applause."

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PROSPECTIVE CLASS MOTTOS.

Seniors—"*Wir wollen Deutch sprechen, oder nicht sprechen.*"

Juniors—"Give us mathematics or give us death."

Sophomores—"We ought not, must not, will not die."

Freshmen—"Work, for the night is coming."

THE COLLEGE WORLD.

Butler wants more light in the college buildings.

Professor in Logic discussing terms—"Does man properly embrace woman?"

Lehigh University will charge tuition to all that enter after January 1, 1892.

Daniel Webster is said to have originated college journalism in this country at Dartmouth in 1800.

The University of Wisconsin has abolished examinations, except where the class standing falls below 85 per cent.—*Ex.*

Luther H. Cary, the noted sprinter of Princeton, has left college and retired from the track. He is now engaged in business in Chicago.

Stevens Institute is considering the lengthening of its course to five years. Harvard and Columbia are discussing shortening their courses to three.

The students of the Rensselaer Polytechnic Institute have adopted an Institute badge in the form of a button representing the target of a leveling rod.

Oxford University will send an eight-oared crew to Chicago for the World's Fair if it can be assured that American college crews will be there to compete.

The University of Berlin, one of the seats of the highest German learning, with its 6,000 students and scores of famous professors, is said to have a capital of but $750,000.

Here is the libretto of the song with which Palo Alto manifests its presence:

Roar, roar, roar!
Roar, roar, roar!
Le-land Stand-ford, Jun-i-or.

Purdue has an Electrical and a Civil Engineering Society, each of which meets bi-monthly.

The *University Argus* of the Missouri State University suggests that their young looking professors wear badges so that they may be readily distinguished from the students.

The Czar of Russia has sent to Stanford University a collection of rare minerals valued at $35,000. Senator Stanford will probably reciprocate by sending a collection of American minerals to St. Petersburg.

Germany has begun to feel the modern reaction against the classics. A strong body among the university professors is endeavoring to have modern languages and the sciences take the places of the classics in the *Gymnasia.*—*Wesleyan Argus.*

When German students "flunk" it seems that they kill themselves. It is reported that in the last six years 389 students of the Prussian schools have committed suicide on account of failure in examinations. We do things differently on this side of the water.

At New York University a trophy that is anxiously sought is a musty bun, in a glass and silver case, which since 1885 has been handed down by vote to the most popular class in college. '91 turned it over to '93, and now rival societies in the class are quarreling over it.

Among other things Yale's new gymnasium will have a swimming tank fifty-five by twenty-five feet deep. Rowing tanks fifty by thirty feet each, for the University and Freshman crews. The running track will be thirteen laps to the mile, circling the walls of the great hall or gymnasium proper.